Feature Extraction in an Aerial Photography of Gimnyeong Sand Dune Area by Texture Filtering

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Abstract: To find the best way to distinguish sand dunes from urban building and rural patches, textural analysis has been performed in Kimnyeong sand dune, Jeju. An aerial photo was re-sampled into one-meter. Homomorphic filters were applied to the original sub-scene and then high-pass filtered one. The entropy filtered one proves to be the best extraction method after high pass filtered-homomorphic filters in urban areas. The spectral values of sand dune area were similar to open land in rural area. In contrast, the texture values of sand dune area are more homogeneous than those of open land in rural area.

Keywords: Sand Dune, Homomorphic Filter, Texture Analysis

1. Introduction

Study site is located on the northeastern part of Jeju Island. The sand dune penetrated into the island from northwest to southeast with diagonal direction. The sand dune is 12 km long and 4 km wide. Sands of shell fragments cover the lowlands between lava flows (Fig.1).

Sand dunes have drawn a great attention among the coastal landforms in these days. Earlier research works which used remotely-sensed data, however, focus on the seasonal patterns and bio-geochemical process in sand dunes; the satellite data and aerial photos have been used only as a backdrop or for the multi-temporal delineation of sand dune area by simply digitizing. In order to find the best way to extract features'

characteristics including sand dunes, urban building and patches in rural areas, Kimnyeong sand dune area was selected as a study site (Fig. 2). Field works have been carried out three times to collect ground control points and to sample sand for physical and chemical analyses. The texture of sand dune is classified as fine sand, which is supposed to have been derived from shell fragments.

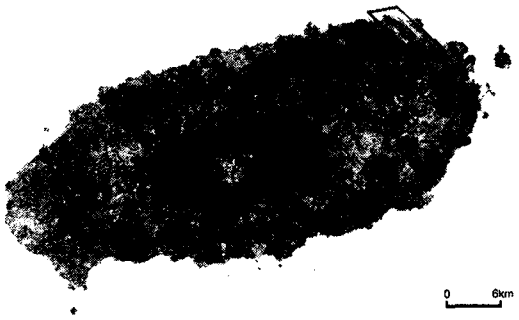

Fig. 1. Study site.

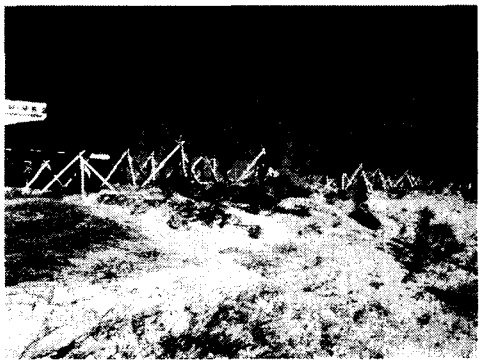

Fig. 2 Protection of shoot areas to avoid wind damage in the study site.

2. Methodology

An aerial photo taken in 1979 was re-sampled into one-meter resolution deliberately and rectified by nearest neighborhood re-sampling method with software such as Erdas Imagine 8.6 and ENVI. Work flow diagram for the study can be summarized as Fig. 3. The reason for the re-sampling is to simulate the images which will come from the future satellite available in 2005. Sub-scenes were chosen as samples for sand dune, urban area and rural area. Variance values of each sub-scene are analyzed and plotted with pseudo-color slicing and histograms of the variance values were plotted after converting texture values into ASCII file format. K-group non-parametric analysis has been done for the geometric and spectral values of enclosed texture patches.

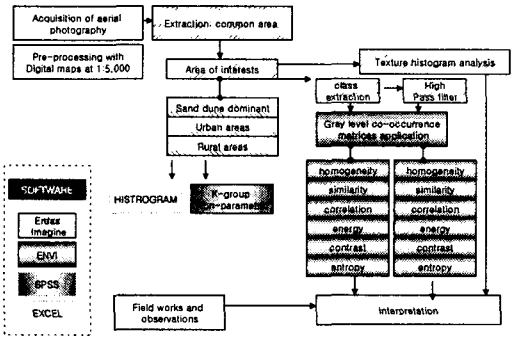

Fig. 3. Work Flow

Image texture, defined as a function of the spatial variation in pixel intensities (gray values), is proven to be useful in a variety of applications and has been a subject of intense study by many researchers. One immediate application of image texture is the recognition of image regions such as dune fields using texture properties.

3. Discussion

Urban areas have significant smaller patches than the others. Homomorphic filters were applied to the original sub-scene and high-

pass filtered one. Sand dune area has similar pattern in the size of patch to rural area. The high texture values of sand dune are similar to those of urban area. The entropy filtered one proves to be the best extraction method after high pass filtered-homomorphic filters in urban areas. The spectral values of sand dune area are similar to open land in rural area. In contrast, the texture values of sand dune area are more homogeneous than those of open land in rural area. The reason for the meaningful result of texture analysis is due to the strong contrast between artificial walls made of dark basalt and white fine sand.

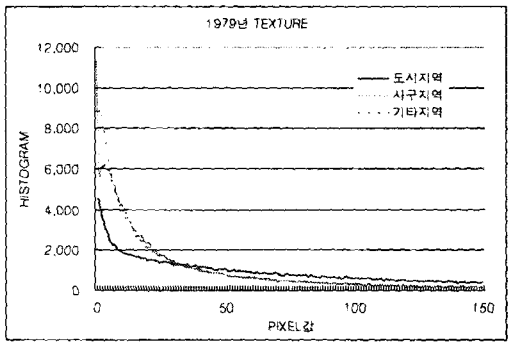

Fig. 4. The distribution of texture pixel values.

The distribution of texture pixel values for the rural area (dotted line), urbanized area (thick solid line) and rock fenced sand dune area (thin solid line) can be summarized as Fig.4. Urban areas show both higher reflectance values and relatively higher texture pixel values as well. Sand dune areas exhibit consistently lower texture pixel values (<3) due to the homogeneity of sand dunes.

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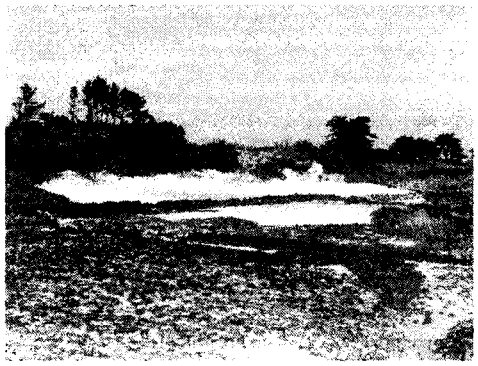

Fig 5. Partly vegetated sand dune surrounded by basalt walls which shows dramatic changes in texture values.

4. Conclusions

Sand dunes in Jeju Island are characterized by its deep penetration into the land, therefore textural analysis is proved to be very effective to delineate dune area due to the color of basalt walls surrounding plots. Field works and physical analysis found that dune sands are shell fragments and very fine sands

Instead of using aerial photos as it is to delineate dune area, we decreased precision level of aerial photos to KOMSAT 2 level deliberately to test the applicability of future satellite. In this respect, we derived slightly different results out of aerial photo analysis. Time sequential analysis of aerial photos for the region is necessary to

understand either the stabilization or expansion processes of dune area, and study of seasonal variations are necessary to understand the dune forming process and enhance the effectiveness of textural analysis.

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